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THE CHANGING ROLE OF
NAVY RESEARCH AND DEVELOPMENT
LABORATORIES IN SYSTEMS ACQUISITION

by

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December 1977

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The role of the Navy Research and Development Laboratories has, historically, lacked precise definition. Budgetary pressures result in a continuing assessment of the in-house laboratory asset requirements. Recent improvements in mission and role assignments and laboratory resource management should be expanded and focused to guide any contemplated changes in the size or the make-up of the laboratory system.

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THE CHANGING ROLE OF NAVY RESEARCH AND DEVELOPMENT LABORATORIES IN SYSTEMS ACQUISITION

by

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ABSTRACT

The role of the Navy Research and Development Laboratories has, historically, lacked precise definition. Budgetary pressures result in a continuing assessment of the in-house laboratory asset requirements. Recent improvements in mission and role assignments and laboratory resource management should be expanded and focused to guide any contemplated changes in the size or the make-up of the laboratory system.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

I. INTRODUCTION

A. GENERAL

In this post war era, the Federal Government is confronted with changing budget priorities for national defense and social programs. Depending on the assumed threat, there is a reduced dependence on the Navy contribution for national defense. In light of this, the Navy must consider a variety of alternatives for maintaining an effective Naval Force with relatively smaller budgets.

There have been a myriad of studies conducted to determine the need for the Department of Defense (DoD) Laboratories and recommendations for improvement. The consensus of opinion from the various studies is that (1) the laboratories are needed and (2) a variety of improvements are in order. There is no clear definition of the role of the Navy Laboratories and a number of institutional and management problems hinder the coalition of the Laboratories/Centers into an efficient Center/Laboratory system (Hillyer 1977).

The DoD in-house laboratory system is large and complex. An underutilization of the existing laboratory capabilities, and an active government policy to increase the private sector's share of DoD Research and Development (R&D) is resulting in a number of changes in size and make-up of the DoD Laboratory system. Long range DoD Laboratory recommendations are to reduce both the Army and Navy Laboratory complex in a surgical manner such as to maintain the necessary overall defense capability (Allen 1975).

It is the premise of this thesis that an objective technology audit of private and Government R&D organizations claiming technological expertise, facilities, and accomplishments will show where the R&D dollars should be efficiently concentrated. Such an audit would focus R&D efforts along the lines of proven performance and capabilities according to national priorities. A mechanism is needed to bring forward the unique ideas for serious consideration regardless of the originating agency or person(s).

For simplicity, labs, laboratories and centers are used synonymously in this thesis.

B. PURPOSE OF THESIS

The purpose of this thesis is to examine the role of Navy R&D Laboratories in terms of missions assignments and capabilities, changing government-wide procurement policy, and organizational change management. This thesis is intended to (1) identify Naval Material Command (NAVMAT) Laboratory roles, resources and capabilities to the Navy operational users, (2) identify the magnitude and current status of Navy R&D Laboratory resources for high government level management purposes, and (3) to suggest strategies for organizational change.

This thesis is not intended as a history report, although brief laboratory history outline and references are provided. The problem of utilization of the federal laboratories for all United States government agencies is

recognized and addressed, however, the details of this thesis are largely limited to the NAVMAT Navy R&D Laboratories.

It is hoped that the results of this thesis suggest a rational approach to an optimum management and utilization of the Navy Laboratory system and that this in turn will serve as an example for other Federal Agencies Laboratory management. Recognition of some of the organizational and political factors are examined for influence on the role of laboratories in systems acquisition.

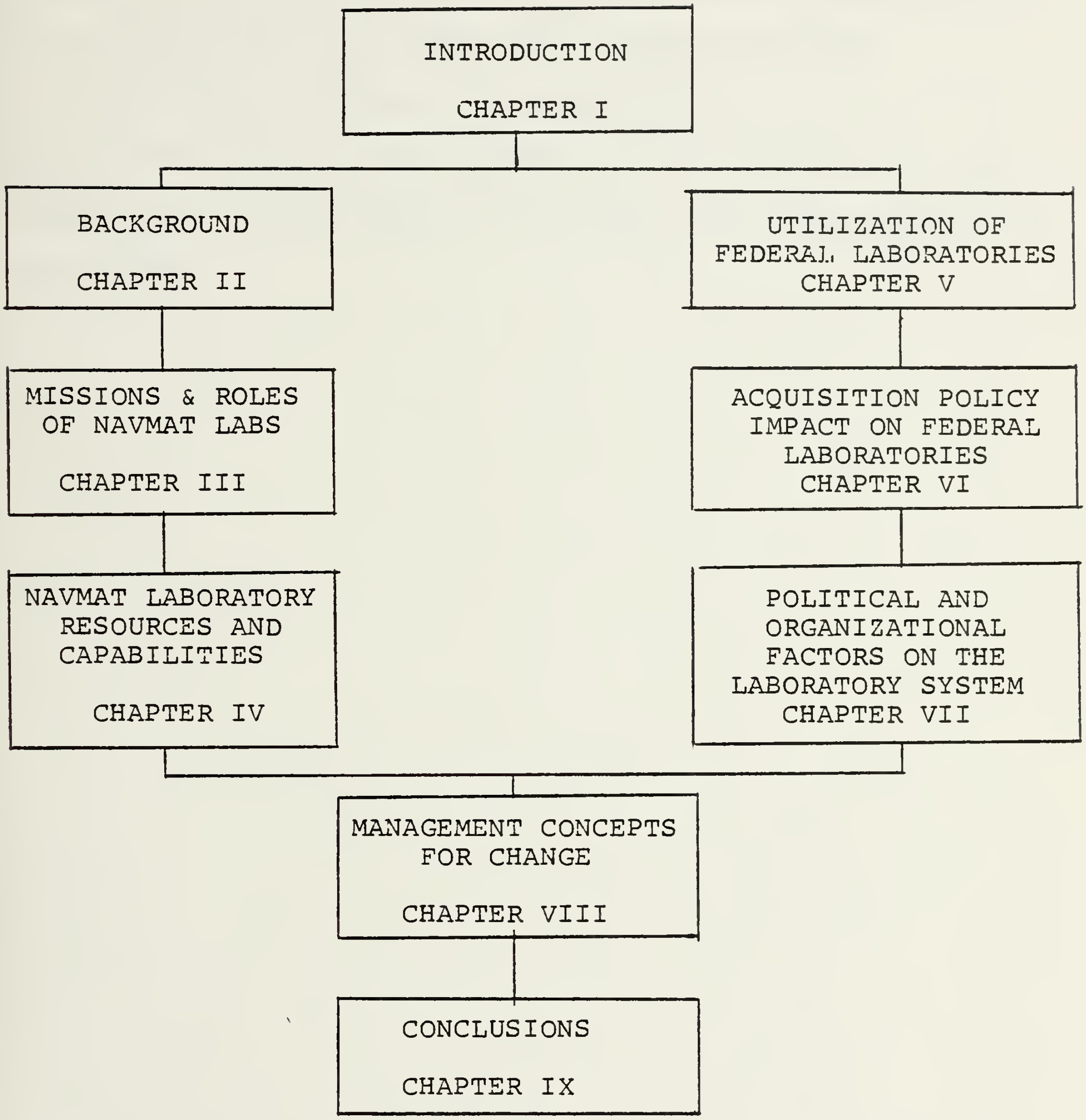
C. METHODS OF RESEARCH

An extensive literature search was performed to develop the role of the laboratories from the time of the Navy military scientific community inception during World War I to the early 1970s. Personal interviews and correspondence examine the period from 1974 to the present (late 1977).

This writer's experience in the active military (United States Air Force), as a Defense Contractor (7 years) and as a Laboratory Scientist/Manager (10 years) provided necessary insight for understanding the contributions and motives of those engaged in weapon acquisition.

D. THESIS ORGANIZATION

Figure 1 is an organizational flow diagram for this thesis. The right path represents general observations of the Federal Laboratory system. The left path represents a narrow view of the NAVMAT Laboratory system. While this



Thesis Flow Diagram

Figure 1

thesis is intended to be an unbiased and scholarly view of the organizational factors of systems acquisition, it is only fair to warn the reader of this writer's prejudice to his current job as a Laboratory Scientist/Manager.

Any errors in facts and interpretation, to the extent in which they affect the conclusions and recommendations of this thesis, are solely the responsibility of the author.

II. BACKGROUND

A. INTRODUCTION

The Navy Laboratories have long been partners in the Weapon System Acquisition (WSA) process along with the Naval Material Command (NAVMAT), the Navy Systems Commands (SYSCOMS), Industry, and recently the joint services. A historical evolution of the federal laboratories, and, in particular, the establishment of the Navy scientific community is useful since some of the problems evident at the inception of this community remain today. The following history of the Navy scientific community was predominantly abstracted from the book "Sailors, Scientists, and Rockets" (Christman 1971).

B. HISTORY

1. Founding of Government Laboratories

The DoD in-house R&D organizations trace their history back to the establishment of the Springfield Arsenal in 1790. The traditional role of the Arsenal systems was for the production of war materials.

Prior to World War I (WWI), Navy weapons were produced under the control of the Bureau of Ordnance and the several Naval Ordnance Stations. These stations were commanded by Officers who had both ordnance experience and considerable sea duty. The stations missions ranged from gun and powder factories to ammunition depots. Example of this kind of activity was the Naval Gun Factory at Washington, D. C.

which had a century of ordnance experience by the time of WWI. This expertise was instrumental in a technology transfer leading to a rapid production of guns and ammunition by the industrial base during WWI. The mission of production of war materials was specified by Congress in 10 U.S. Code 4532 during WWI which stipulated that:

> "The Secretary of War should have his supplies made in factories or arsenals owned by the United States, so far as those factories or arsenals can make those supplies on an economical basis".

2. Founding of the Navy Scientific Community

Secretary of the Navy Daniels, along with the American public, was shocked by the news of the sinking of the unarmed passenger liner, the Lusitania, on the afternoon of May 7, 1915, by German torpedoes. He recalled a recent newspaper article in which the famous inventor Thomas A. Edison had expressed his views on how technology could be put to better use for the national defense. At the time, Edison was 68 years of age and had, as reinforcement to his own inventive mind, a well staffed industrial research laboratory at West Orange, New Jersey. Daniels wrote Edison and began an exchange which led to the appointment of Edison as head of the Navy Consulting Board in July of 1915, but a year passed before the board was given official status and was granted $25,000.00 for expenses. This is considered to be the earliest beginnings of the Navy's Scientific R&D Community.

In this same period, a Council of National Defense was established that was essentially the President's War

Board (Secretary of War, Interior, Agriculture, and Labor), and the Navy Consulting Board was made the Official Board of Inventions. The most aggressive action of the Navy Consulting Board was to conduct a publicity campaign by it's Committee of Industrial Preparedness. On March 15, 1916, concurrent with the Preparedness Campaign, Secretary Daniels, Thomas Edison, and three other members of the board appeared before the Committee of Naval Affairs of the House of Representatives and presented a proposal for the Naval Research Laboratory. The proposal was for a laboratory with significant involvement in applied weapons research as distinguished from basic research. Edison was a man of ideas, sometimes of differing ideas. Extracts of his concept of the laboratory follow:

> "As to the character of the laboratory itself, I recommend that it be one that is constructed, arranged, and run as a works for the rapid construction of experimental machines and devices...
>
> The great practical inventor elaborated...
>
> "I do not think that scientific research work to any great extent will be necessary. Research work in every branch of science and industry, costing countless millions of dollars and the labor of multitudes of men of the highest minds, has been carried on for many years. All of this has been recorded, and yet a ridiculously small percentage has yet been applied and utilized. It is therefore useless to go on piling up more data at great expense and delay while we are free to use this ocean of facts.
>
> "As to the management of the proposed laboratory, I believe it should be civilian".

The biggest job of the consulting board turned out to be screening of inventions of possible application to the war. There was unbridled optimisn that "good old yankee ingenuity" would provide a unique weapon that would quickly

turn the tide of battle, and indeed, a tidal wave of ideas and inventions swept toward Washington from across the nation. At the crest of the wave, 600 letters a day poured in.

Of the 110,000 suggestions that came to the board and the Navy from the public, about 110 had enough merit to be submitted by the senior examinors to the committee, where they were reviewed by members of the board cognizant of the particular area. Of these 110 ideas, only one was put into production. The inventions by the members of the board were of a different caliber, but the results were much the same. The most prolific contributor was Edison himself, along with his large and able staff in the Edison laboratory.

Some devices representative of his work are listed below:

-A sonic apparatus for detecting submarines

-A device for covering merchant vessels with smoke

-Quick-turning apparatus for ships to avoid torpedoes

-Antitorpedo Nets

-Manned buoys for coast submarine patrol

-Compound for smudging enemy periscopes

Afterward Edison said:

> "I made about forty-five inventions during the war, all perfectly good ones, and they pigeon-holed every one of them. The Naval Officer resents any interference by civilians. Those fellows are a close corporation."

The earliest traceable roots for what emerged as the Navy Laboratory system has its beginnings at Clark University

in the work and words of Dr. Arthur G. Webster, pioneer American Ballistician and early advocate of scientific involvement in national preparedness. Webster was profoundly influenced by German research. He served for three years under Dr. Albert A. Michelson, the famous Nobel Prize winner with a Naval background. Webster's first assistant at Clark Universities Ballistic Institute was Louis Ten Eyck Thompson, who became the Navy's first civilian ballistician involved in peacetime ordnance development at the Naval Proving Ground (NPG) Dalgren and later became the first Technical Director of the Naval Ordnance Test Station (NOTS). Dr. L.T.E. Thompson profoundly affected the philosophy of weapon research in the Navy. Two other members of the Ballistic Institute at that time, Dr. Robert Goddard and Dr. Clarence N. Hickman, would become pioneers in American rocketry.

The Bureau of Ordnance and the industrial base had more than two years of preparing for war production prior to 1917. Even so, as of January 1, 1917, the Bureau of Ordnance consisted of 13 officers and 39 civilians (mostly clerical). While there was a rapid build-up of war related scientific effort, most of the WWI work was done at the existing Ordnance Stations. Upon the armistice signing on November 11, 1918, all war related research came to a standstill (Christman 1971).

There was a remarkable influence of WWI upon the manner in which the next world crisis would be met. World

War II (WWII) preparation included applying the lessons learned from WWI regarding the use of science. This led to the greatest scientific mobilization known to man. Throughout WWII, the scientific community exhibited a "can do" response to the military needs. Permanent R&D laboratories were established (such as the Naval Ordnance Test Station (NOTS), China Lake, California, and the Naval Ordnance Lab (NOL), White Oak, Maryland) and staffed with a close knit team of military and civilian scientists. The laboratory system contribution to the war included such military products as penetrator weapon fuzing, high-speed torpedoes, rockets nuclear weapon components and radars.

The basic principles of the military/civilian joint operations management were established in late 1946 with the NOTS and NOL organizational structure and "Principles of Operations" approval by Admiral Hussey. These laboratory charters were designed to allow a strong measure of scientific freedom and initiative within the overall framework of Navy administration. This action ultimately influenced the operational philosophy of other military R&D laboratories. This team operational philosophy was maintained for many years with increased or decreased emphasis depending on top management personalities.

For a variety of reasons, not explored herein, the laboratory operational behavior began a gradual trend toward a more military type of operational principle in the late 1960s.

The military R&D activities in the late 1940s were typified by no formal R&D planning process, no separate appropriation and no detailed R&D procedures. In contrast, Navy R&D management in 1974 was characterized by numerous organizational and procedural complexities (Qurollo 1974).

There is a normal pattern of cycle of national defense activities (R&D and production both in-house and out-house) which corresponds to periods of war or limited conflicts. The pattern of winding down these war related efforts follows shortly after the war; at least through the Korean War.

The current position in the military cycle is one of winding down the prolonged activity associated with the Viet Nam conflict in the face of a growing awareness of the Soviet War capacity.

Documentation of the corporate memory of significant events in the evolution of Navy R&D management since WWII is detailed in the comprehensive report "Review of Navy R&D Management, 1946-1973" (Booz-Allen & Hamilton, Inc. 1976).

III. MISSIONS AND ROLES OF NAVMAT LABORATORIES

A. INTRODUCTION

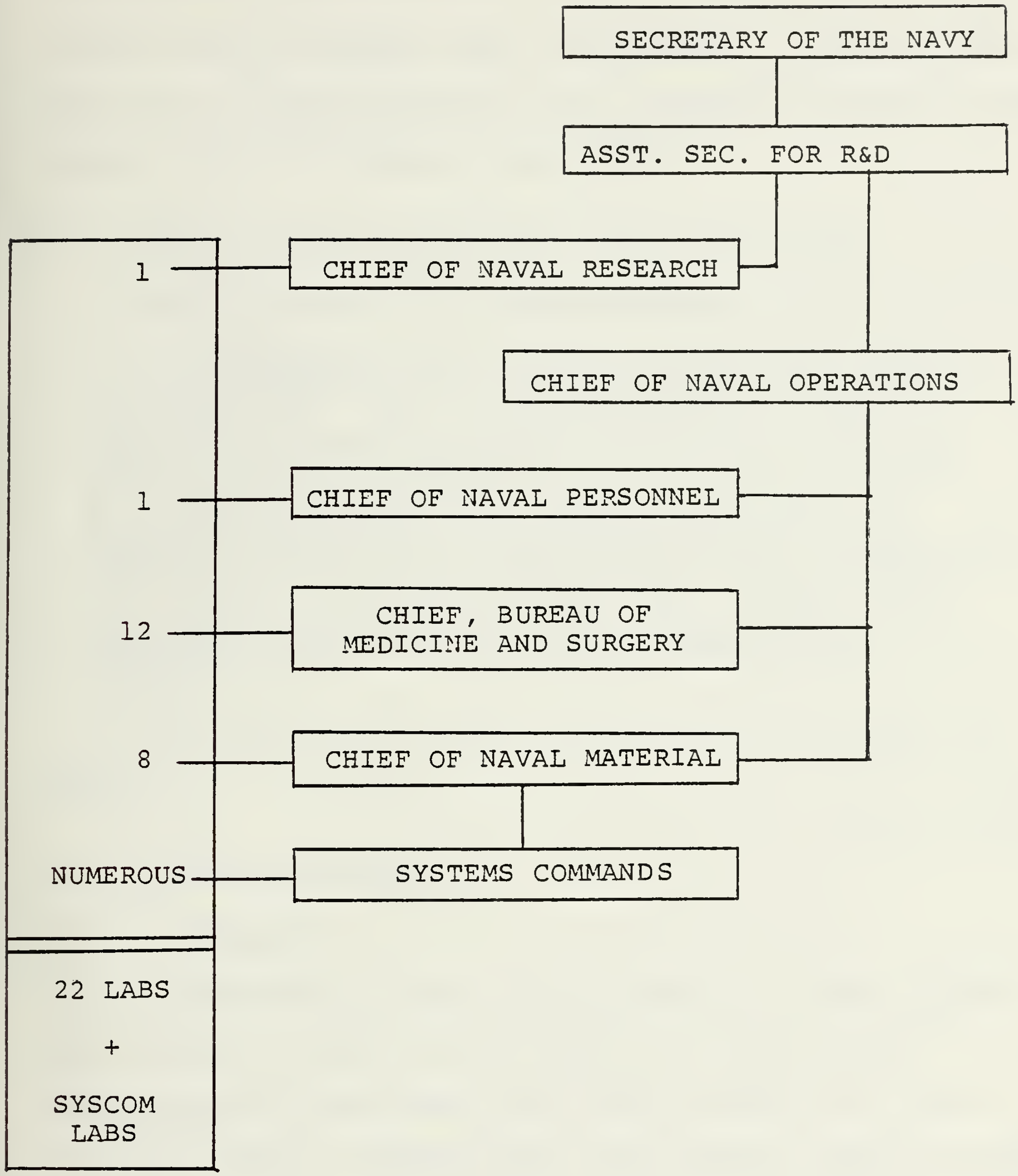
In 1966, the Chief of Navy Material (CNM) assumed command of the major Navy Laboratories. In the next four years the fifteen laboratories that then existed were consolidated into seven research centers and three supporting laboratories. The purpose of the consolidation was to bring together in a single command the various capabilities necessary to attack complex military problems in specific warfare areas (Munro 1973).

Subsequent consolidation has resulted in eight (current) NAVMAT commanded laboratory/centers. NAVMAT also indirectly commands numerous SYSCOM laboratories. Figure 2 shows the NAVMAT Laboratories command chain.

Some of the Navy missionsand roles are supported by the Federal Contract Research Centers (FCRCs). A recent study recommended "that the FCRCs be retained and protected in essentially their present roles". This recommendation was meant to read as a strong endorsement of current defense policy in utilization of the FCRCs (Office of the Director of Defense Research and Engineering (ODDR&E) 1976).

B. ESTABLISHING NAVMAT LABORATORY MISSIONS AND FUNCTIONS

In 1974, an ad hoc panel established bv RADM F. C. Jones DCNM (Development) undertook a review of laboratory missions and functions (Hollingsworth 1974). This review was a major input to the NAVMAT instruction which defined for each of the (then) 9 NAVMAT laboratory/centers, Naval Research Lab (NRL) and Civil Engineering Lab (CEL) their missions and



Naval Laboratories Command Chain

Figure 2

functions in terms of product areas and product lines (NAVMATINST 5450.27A 22 Dec 1975). Further, the laboratories were to develop with the sponsors a five-year plan which sets forth anticipated work assignments based on the latest five year defense plan (FYDP).

C. CURRENT NAVMAT LABORATORY ROLES AND MISSIONS

NAVMAT Corporate Plan for Laboratories states:

> "The specific roles, functions and operations of these lab/centers are stated in NAVMATINST 5450.27A of 22 Dec 1975. This instruction was developed to redress the imbalance between competition and cooperation by refining the roles and responsibilities of the CNM in-house lab/centers and of industry. The instruction also made provisions for the lab/centers to maximize the utilization of the expertise and facilities available from other labs and activities, particularly those within DoD, to avoid non-essential duplication of existing capabilities" (Probus 1977).

The missions of the CNM Laboratories are listed in Table I.

D. LABORATORY STUDIES

1. General

Probably no class of institution has been studied and analyzed, praised and criticized, organized and reorganized to the degree that has been the lot of the in-house defense laboratories (Glass 1967). Table II shows a summary of the various laboratory studies. Data shown through the year 1973 was taken from "Review of Navy R&D Management, 1946-1973" (Booz-Allen and Hamilton, Inc. 1976). An Office of Naval Research (ONR) report provided additional data on laboratory studies (Mindak 1974).

TABLE I

Missions of CNM Laboratories and Centers

NAVAL AIR DEVELOPMENT CENTER (NADC)

The principal RDT&E center for naval aircraft systems less aircraft-launched weapon systems.

NAVAL COASTAL SYSTEM LABORATORY (NCSL)

The principal activity for conducting RDT&E in support of Naval missions and operations that take place primarily in the coastal (continental shelf) regions. Includes RDT&E for mine countermeasures, diving and salvage coastal and inshore defense (less ASW), swimmer operations and amphibious operations.

NAVAL OCEAN SYSTEMS (NOSC)

The principal RDT&E center for command, control and communications; ocean surveillance; surface and air launched undersea weapon systems and supporting technologies.

NAVAL PERSONNEL RESEARCH AND DEVELOPMENT CENTER (NPRDC)

The principal Navy activity for conducting human resources RDT&E in the areas of manpower, personnel, training and education; serves as coordinating activity for all human resources RDT&E for the Navy. Also provides RDT&E support and services to the Systems Commands and to CNM laboratories as necessary to augment and stimulate human factors efforts in the RDT&E new systems for operational use.

DAVID W. TAYLOR NAVAL SHIP R&D CENTER (DTNSRDC)

The principal RDT&E center for Naval vehicles and logistics; provides RDT&E support to the U.S. Maritime Administration and the maritime industry.

NAVAL SURFACE WEAPONS CENTER (NSWC)

The principal RDT&E center for surface weapons systems, ordnance, mines, and strategic systems support.

NAVAL UNDERWATER SYSTEMS CENTER (NUSC)

The principal RDT&E center for submarine warfare and submarine weapon systems.

NAVAL WEAPONS CENTER (NAVWPNCEN)

The principal RDT&E center for air warfare systems (except ASW systems) and missile weapon systems.

Date	Name of Study	For	Conducted by	Purpose and Scope
1947	Steelman Report	President	President's Scientific Research Board	A comprehensive review of science and public policy including research administration, personnel problems, and the Government's policy.
16 April 1954	Gates	SECNAV	In-house Committee on Organization of DON	Review organizational structure of DON to identify overlapping or duplicative functions, problems and difficulties.
4 August 1954	Riehlman Sub-committee	Congress	Subcommittee of Committee on Government Operations	Organization and administration of R&D in DOD.
May 1955	Second Hoover Commission	Congress	Commission chaired by Herbert Hoover	Comprehensive review of the Executive Branch of the Government.
1958	Strengthening American Science	President	President's Science Advisory Committee	Report on the federal government's role in science and technology.
31 January 1959	Franke Board	SECNAV	In-house committee on organization of the DON	Review of organization of the Navy in view of DOD Reorganization Act of 1958 and technological advances since the Gates report.
1 June 1959	A. D. Little	NRAC/ SECNAV	A. D. Little, Inc.	Review basic research in Navy for appropriate level, etc.
1961/1962	Task Force 97	SECDEF	In-house committee chaired by Deputy DDR&E	Review of operations of in-house laboratories and recommendations of changes.
17 May 1962	Bell Report	President/ Congress	Cabinet-level committee chaired by D. Bell, Director, Bureau of Budget	Comprehensive review of Government contracting for R&D to improve effectiveness.
April 1962	Astin Panel	Federal Council for Science and Technology	Standing Committee of FCST	Study of factors affecting ability to select, recruit, develop, and retain superior scientific and engineering personnel in the Federal Government.
6 September 1962	Furnas Report	SECDEF	Defense Science Board Subcommittee	Review of "health" of DOD laboratories and recommendations of improvements. Also review of Bell report and development of recommendation.

Table II

Summary Chart of Studies Bearing on Defense In-House Laboratories

Date	Name of Study	For	Conducted by	Purpose and Scope
15 December 1962	Dillon Review	SECNAV	Committee of in-house representatives and consultants	Comprehensive review of entire Navy organization; in-depth review of functions and operations down to and within bureaus and offices.
1963	Task 97 Action Group	OSD	DOD/Civil Service Commission	Review and followup on problems and recommendations identified in earlier studies/reports.
November 1964	Sherwin Plan	DDR&E	Chalmers Sherwin (Deputy DDR&E)	Improvement of operation and management of DOD in-house laboratories.
17 December 1964	Task Group B	ASN(R&D)	In-house group headed by RADM Ruckner	Enable ASN(R&D) to respond to Sherwin Plan.
4 January 1965	On the Management of Navy Laboratories	SECDEF	Dr. Robert Morse, ASN(R&D)	Navy Department response to Sherwin Plan based on five in-house task group studies by Radm. Ruckner, et. al.
January 1966	Navy Laboratory Report	DDR&E	Dr. Robert Morse, ASN(R&D)	Navy Department response to DDR&E on future priority R&D requirements and in-house capabilities.
August 1966	DSB Report on In-House Laboratories	DDR&E	Defense Science Board Committee	To evaluate services' 10-year plan for meeting top priority problems and developing effective laboratories and weapons systems centers.
25 October 1966	Problems of the In-House Laboratories and Possible Solutions "42 Problems"	DDR&E	Office for Laboratory Management (ODDR&E)	Review and collate problems identified in eight major studies between 1962 to 1966.
6 December 1966	Benson Study	SECNAV/ CNO	In-house group chaired by RADM Benson	Review Navy Department staff functions in light of switch from bilateral to unilateran system.
27 December 1967	Problems in the Management of Department of Defense In-House Laboratories	CSC and DDR&E	DOD/Civil Service Commission	Visit 47 key defense laboratories to identify, review, and resolve personnel management problems.
14 December 1968	Action Plan	Deputy SECDEF	ASN(R&D)	Describe actions taken or proposed by the Navy to resolve personnel problems identified in 1967 CSC report.

Table II

Summary Chart of Studies Bearing on Defense In-House Laboratories (Continued)

Date	Name of Study	For	Conducted by	Purpose and Scope
18 December 1969	Allocating Work, Funds, and Man-power to DOD Laboratories	Deputy SECDEF	SECNAV (In-House Task Groups for Navy)	Explanation and review of PPBS as it pertained to allocating work, funds, and manpower to the Navy Laboratories - Incorporated into OSD evaluation and coordinated DOD-wide review.
27 May 1970	Realignment of the CNM RDT&E Facilit-ies 1966-1970 (and Addendum 1970-1975)	NSRDC	NAVMAT	Review of the status and proposed plans for creation of major mission-oriented centers.
1 July 1970	Blue Ribbon Defense Panel	President/ SECDEF	Distinguished out-of-house committee	Study of entire organization and structure of DOD.
1971	Plan for improving the Effectiveness and Utilization of the Navy's In-House Laboratories	DDR&E	DNL	5-year, time-phased Navy plan of action for improving its laboratories - Integrated into 1971 Glass Committee review.
1 July 1971	Glass Committee	SECDEF	In-house group chaired by Dr. Glass	Review of BRDP report and review of DOD laboratories and Service recommendations and plans for their improvement.
18 August 1972	State of the Laboratories	Deputy SECDEF	DNL	Status report on implementation of proposed plans and Glass Committee recommendations for improving the laboratories.
December 1972	Commission on Government Procurement	Senate	Hi-level, Congressional, Industry, Government team	Broad, in depth study of procurement practices government wide.
August 1973	Evaluation of Pro-ject REFLEX within the Navy	Navy	DNL	Evaluation and recommendation regarding 3-year demonstration experiment directed by DDR&E and conducted in three Navy laboratories.
1973	Project REFLEX--A demonstration of Management through use of Fiscal Controls without person-nel ceilings (DOD)	Congress	Comptroller General of the U.S. (General Accounting Office)	Evaluation of the effect of the Project REFLEX experiment with recommendations.

Table II

Summary Chart of Studies Bearing on Defense In-House Laboratories (Continued)

Date	Name of Study	For	Conducted by	Purpose and Scope
1974	NMARC Study	SECNAV	NMARC	Navy Systems Acquisition Process study.
August 1974	Hollingsworth Report	NAVMAT	ad hoc panel established by RADM F. Jones	Review and recommendations of laboratory missions and functions.
August 1974	Hazen Report	DDR&E	NRAC	Review laboratory organization structure and Navy utilization of laboratories.
30 August 1974	Connolly Report	ASN	NMC	Consolidation Feasibility study for NOL, White Oak and NWL, Dalgren.
28 April 1975	Allen Report	SECDEF	ODDR&E	Determine requirements for DOD Laboratories.
February 1976	FCRC Study	DDR&E	Hi-level Task Force	To examine the DOD policy in the use of FCRCS.

Table II

Summary Chart of Studies Bearing on Defense In-House Laboratories (Continued)

2. <u>Impact of Recent Studies</u>

Much of the recent studies were summarized in the "Allen Report", 1975. This report is examined in some detail here as it appears to be having significant impact on size and makeup of the laboratory system.

a. The Allen Report

The DoD Laboratory Utilization Study was initiated in 1974 by Dr. M. R. Currie, DDR&E, in response to management objectives stated by the Secretary of Defense. This study focused on four basic issues (Allen 1975):

1) Are DoD in-house labs needed?
2) How should RDT&E be organized and managed?
3) What should be the in-house ratio of RDT&E effort?
4) What is the proper size of the lab complex?

The Navy input to this study concluded the following (Hazen 1974):

1) Navy labs are needed and resources are reasonably matched with requirements.
2) Navy technology base efforts are unduly fragmented.
3) That Navy early R&D and technology base programs ought to be under a single command to be entitled 'The Chief of Naval Research and Technology'.

The ODDR&E follow-on study concluded that there is a vital role for the laboratories that is not satisfactorily available from other sources such as industry, universities, FCRC's, SYSCOMS, etc. The combination of attributes possessed by the laboratories include (Allen 1975):

1) Planning of systems development acquisition and the useage and planning of the Technology Base program to support future systems development.
2) Providing technical advice and supervision to the service agency in the systems acquisition developments and purchases.
3) Providing an alternate source of technology (competition) so as to stimulate industry performance.
4) Providing centers of excellence in areas of little or no industrial interest.

The ODDR&E concluded that the following problems exist and recommended that the Navy undertake their solutions:

1) Redundancy in function/platform assignments and concomitant escessive interlaboratory competition for funds.
2) Technology base fragmentation, uneven quality and inhibited technology transfer.
3) Lack of a system for control of individual laboratory size and technology base in-house/out-house contract ratio.

4) Under utilization of junior officer personnel in the laboratories and overdependence on senior officers for positions of technical responsibility.

Further, there is excessive in-house effort in the Navy for materials and structures, electronics and conventional weapons. This study recommends a reduction in strength of 10 to 15% of the people in the DoD Laboratory system (strength then was 56,000) to take place in FY 76 and FY 77 (Allen 1975).

b. The NMARC Report

In 1974, the Secretary of the Navy established a Navy/Marine Corps Acquisition Review Committee (NMARC) to study the Navy's system acquisition process and to make recommendations for changes and improvements. With regard to the generation of requirements the R&D panel of the NMARC noted the organizational imbalance in the Navy user-producer relationship and recommended that the role of users and producers need to be clarified with regard to (1) authority, responsibility, and accountability for control of R&D funding and (2) the generation of requirements.

Among problem areas highlighted by the NMARC study were:

1) Due to competition and scarcity of funds, mission sponsors are reluctant to fund for contingencies or to explore alternative options.

2) Pressure to select an approach without adequate assessment of risk.

3) Over-optimism or salesmanship on part of R&D community.

4) Over-emphasis on need for early introduction of hardware into fleet.

The NMARC recommended certain organizational and procedural changes to improve the situation.

E. DEPARTMENT OF NAVY LABORATORY (DNL) CORPORATE LONG-RANGE PLAN

Individual laboratory/NAVMAT long-range plans were combined into an initial corporate plan which summarizes (1) the DNL corporate goals, objectives and initiatives; (2) projections for planning; (3) product area summary and analysis; and (4) DNL executive assessment. This plan is to be updated annually (Probus 1977).

The primary goal of the DNL corporate plan is to clarify laboratory/center missions and functions. Goal A is:

> "To emphasize within the lab/center complex the need for clear understanding, acceptance and observation of assigned missions and functions in order to reduce undesired competition and to foster maximum cooperation in the development of knowledge and products to meet Navy needs" (Probus 1977).

This corporate plan calls for the lab/centers to utilize the expertise and facilities available from other labs and activities, particularly those within DoD, to avoid non-essential duplication of existing facilities. Further, it is expected that the labs/centers will function increasingly as a federation, or community of closely cooperating centers.

F. MISSIONS AND ROLES ENFORCEMENT

Each laboratory plays unique, but not mutually exclusive, roles. A certain degree of overlap of work assignments and activity initiated technology exploration is inevitable, if for no other reason, due to lack of complete communication and coordination within NAVMAT Laboratories. This situation is potentially much more redundant when other Navy Laboratories, other service laboratories, other Federal Laboratories, and our NATO allies' R&D activities are considered.

Perhaps the greatest source leading to redundant activities is the difficulty in defining systems boundaries. There is a natural inclination, in the interest of completeness, to define a limit of system responsibility as one element beyond the perceived system boundary.

The CNM intends to "monitor planned work assignments" and "adjudicate conflicts among laboratories and sponsors competing for limited resources" (NAVMATINST 5450.27A 1975). However, overlap of laboratory activities remains and there is no evidence of high level coordination of government wide laboratory activities (Allen 1975).

There is no activity known to this writer which would assign missions and roles to the entire Federal Laboratory System with goals of concentrating expertise and efficiently applying resources.

IV. NAVMAT LABORATORY RESOURCES AND CAPABILITIES

A. INTRODUCTION

The NAVMAT Laboratory/Center capabilities and resources are complex and extensive. In the aggregate, there are 1.1 million acres of facilities valued conservatively in the billions of dollars, employing 22,000 scientists with an annual expenditure of over 1 billion dollars. Until one examines the details of this complex orgranization, there can be no evaluation (sizing, apportionment) of how well the laboratories function and what changes might be beneficial.

B. NAVMAT LABORATORY RESOURCE INFORMATION

The Federal laboratory resource information is inadequate for use in assessment of the NAVMAT laboratory resources and capabilities. This inadequacy is in terms of data content. NAVMAT laboratory resource data should specify human resources, number of acres and where located, unique facilities and capabilities (high-speed rocket sled, underwater torpedo firing ranges, supersonic wind tunnels, etc). Table III is general NAVMAT Laboratory data, however detailed information is readily available from NAVMAT and the individual laboratories. These data serve to identify laboratory facilities and capabilities to the operational forces and other potential users. Laboratory points of contact are included as laboratory resource data are subject to continual change.

Laboratory	NADC	NCSL	NOSC	NPRDC	DTNSRDC	NSWC	NUSC	NWC
Year established (1)	1944	1972 (1945)	1977 (1967,1906)	1973	1967 (1896,1903)	1974 (1929,1918)	1970 (1869,1945)	1967 (1943)
Civilians (FTP)	2310	617	2890	244	2632	5037	3034	4262
Scientists/ Engineers	1134	287	1407	140	1213	2219	1477	1474
Military	254	104	328	22	65	110	146	416
FY 1977 $	215M	34M	185M	13M	124M	220M	238M	227M
Major Sponsor	NASC (85%)	NSSC (66%)	NSSC (25%) NESC (25%)	CNM (81%)	NSSC (72%)	NSSC (56%)	NSSC (69%)	NASC (71%)
Land Owned (Acres)	735	681	505	(2)	296	5368	285	1,094,000
Building (Ft^2)								
RDT&E	833K	326K	977K	(2)	1811K	1664K	909K	101K
Admin	43K	38K	220K	(2)	54K	148K	119K	358K
Other	451K	260K	705K	(2)	402K	1200K	798K	5,735K
Acq. Costs $								
Real Prop.	25M	30M	61M	(2)	67M	91M	58M	222M
Equipment	39M	13M	111M	(2)	45M	73M	117M	78M
Major Capabilities	Aircraft Systems R&D, ASW Warfare R&D	Diving Swimming Device (R&D) Mine & Coastal Warfare	Deep Diving Vehicle R&D, Undersea Surveillance R&D, Communi-cations & Command Control R&D	Training & Human Factor R&D	Naval Vehicle R&D, Wind Tunnels, Acoustic R&D	Surface Weapon Ranges, Weapons R&D, EMV Testing	Torpedo Ranges, Torpedo R&D, Fire Control Systems Sonar R&D	Air Weapons Ranges, Weapons R&D and Systems Integration.
Lab contact	Mr. R.N. Taylor	Mr. W.H. Williams	Mr. E.R. Ireland	Dr. E.I. Jones	Dr. C.M. Schoman, Jr.	Mr. Don Dick	Mr. W.L. Clearwaters	Dr. R.F. Roundtree

(1) Later date is due to reorganizating and/or renaming.
(2) Not Navy Industrial Funded, a tenant of NOSC.

Table III

NAVMAT Laboratory Resource Data

V. UTILIZATION OF FEDERAL LABORATORIES

A. INTRODUCTION

From Fiscal Year 1969 to Fiscal Year 1977, total Federal R&D obligations increased from $15.6 billion to an estimated $23.5 billion, for an annual growth of 5.2%. Most of this growth has taken place in recent years with a rate of 10.4% from 1974 to 1977. Twenty-six billion dollars is an estimate of the Fiscal Year 1978 Federal R&D budget (U.S. National Science Foundation (USNSF) 1976).

About one third of the R&D budget ($8 billion for Fiscal Year 1978) will be expended by Federal in-house centers/ laboratories for salaries, benefits and travel.

The national defense share of total R&D has been averaging over 50% of the total R&D budget. The Fiscal Year 1977 estimates were 51% national defense, 12.5% space, 9.7% health, 8.6% energy and the remaining 18.2% divided among the many other agencies (U.S. National Science Foundation 1976).

B. PROBLEMS IN UTILIZATION OF FEDERAL LABORATORIES

On April 8, 1974, testimony to the hearings before a subcommittee of the Committee on Appropriations, House of Representatives, Ninety-third Congress, Second Session, included an investigative report entitled "Utilization of Federal Laboratories" (U.S. House of Representative Hearing 1975). This report attempted a comprehensive listing of all Federal Laboratories, staffing and equipment.

The summary data reported, as of June 30, 1972, indicated 834 Federal Laboratories with an estimated value in excess of $14 billion. Total laboratory space is 176 million square feet with 260,000 employees (95,000 professional) at an annual salary and benefit cost of nearly $4 billion per year. Travel and all other costs of $2.4 billion bring the total staffing costs to $6.4 billion 1972 dollars (U.S. House of Representative Hearings 1975). Given a 5% per year growth, Fiscal Year 1978 costs of this category would exceed $8 billion. This assumes that the total number of laboratories and employees is constant.

Although 3 million square feet of laboratory space was reported as unoccupied (full value unknown), construction was in progress on 58 additional facilities costing $350 million and renovation underway on 52 existing facilities at a cost of $180 million.

Despite the enormity of the overall investment of the Federal Laboratories and the related operating expenses, there is no Government wide system of review, coordination, and control to insure efficiency and economy of operation. No agency or department, except perhaps the DoD, has made any effective effort to even develop necessary information as to the total laboratory resources available.

The data base used for the "Utilization of Federal Laboratories" report was generated under National Science Foundation (NSF) grants (U.S. National Science Foundation 1973). This report made recommendations regarding

inter-Governmental use of Federal R&D Centers and Laboratories. Among the conclusions of this report were the following:

(1) Federal R&D Centers will never be utilized effectively within the Federal Government itself, let alone inter-governmentally, in the absence of a strong managerial system backed by policy directives.

(2) The OMB should examine the status, roles, and organizational logic of the Federal Laboratory population as an opportunity for reorganization action to capture the efficiencies and economies of scale in utilization which would be expected from an integrated systems management.

VI. ACQUISITION POLICY IMPACT ON FEDERAL LABORATORIES

A. INTRODUCTION

During the 1950 cold war era, there was a perceived technology race against the Soviets. Defense Systems Acquisition strategy could be characterized by having performance and schedule as driving factors. There was little time for requirements definition of major systems. Concurrency in development and production was normal practice. Cost growth, poor performance, duplication of design and effort were prevalent among the services. These problems and many others were detailed by early analysis (Peck and Scherer 1962).

Major System Acquisition reform was sought, and resulted in DoD 3200.9 (1965), a major policy guidance directive issued on Concept Formulation and Contract Definition by Secretary of Defense McNamara. This was the first "building block" in the establishment of a coordinated framework of policy formulation and implementation for DoD systems acquisition. Policy formulation and decision making shifted from the services to the highest levels of DoD. This process eventually led to a formalized decision process which is known today as Defense System Acquisition Review Council (DSARC).

There was a flurry of government studies of the acquisition process during these times. The Blue Ribbon Defense Panel (1969-1970) noted three major deficiencies in requirements definition:

(1) The services were faulted for developing requirements that were <u>too</u> specific.

(2) The <u>needs</u> of the operating forces were being subordinated to the <u>parochial interests</u> within the services.

(3) The services bias towards oversophisticated weapon systems.

These requirement determination criticisms imply that the formulation of needs were still unstructured, uncoordinated and lacked control. The panel further criticized the lack of a meaningful program review after the initial Office of Secretary of Defense (OSD) decision to proceed into Engineering Development, the over optimism of contractors and services to deal with technical unknowns, reliance of "paper studies" versus critical hardware experiments, and the inhibiting effects on innovation after the initial OSD approval.

Mr. Packard's policy guidance of 1970 resulted in DoD 5000.1 and formalized the DSARC process. The intent of this directive was to:

1) decentralize decision making from OSD to the service components,

2) define authority and responsibility for key organizations and individuals,

3) define OSD milestone decision points and substantiating elements.

Due to continuing procurement disasters, Congress commissioned (HR 474, PL 91-129), the Commission on Government Procurement (COGP) in 1969. Unlike most investigations of the acquisition process, the COGP looked at the entire procurement process. The commission's analysis resulted in a recommendation for a complete systems approach to systems and twelve major recommendations which are summarized in Table IV.

Public Law 93-400 established the Officer of Federal Procurement Policy (OFPP) within the Office of Manpower and Budget (OMB) as a result of one of the recommendations of the COGP. OMB Circular A-109, issued in April 1976, addressed Major Systems Acquisitions. Major systems are defined as those costing $75 million R&D or $300 million in production. Lesser dollar value programs are encouraged to follow the A-109 philosophy (OMB Circular A-109 1976).

B. ACQUISITION POLICY ELEMENTS SUMMARY

A summary of acquisition policy elements is as follows:

1. OMB Circular A-76 (1966)

Made it the policy of the Government to rely on the Government sector for such goods as are commercially available, specified goals for the kinds of activities to be contracted out, proportions of in-house versus out-house activities, and comparison standards for judging in-house versus out-house performance. This circular is currently being examined for revision.

TABLE IV

ACQUISITION POLICY CONSIDERATIONS
COMPARISON OF PAST PROBLEMS, CURRENT CHANGES, AND RECOMMENDED ACTIONS
(Department of Defense)

PAST PROBLEMS	MAJOR CURRENT CHANGES	MAJOR RECOMMENDED ACTIONS
ESTABLISHING NEEDS & GOALS		
-Needs/goals set by each service; unplanned duplication	-Mission area coordinating papers	-Agency head reconciliation of needs/goals and service responsibilities
-No formal congressional overview		-Congressional review of mission deficiencies, needs/goals for new acquisition programs
EXPLORING ALTERNATIVE SYSTEMS		
-Centralized agency-level control over systems	-Decentralization; more authority for military services	
-Lack of Congressional visibility; scattered R&D line items		-Congressional authorization and appropriation of RDT&E funds for systems candidates by mission need
-Premature commitment to single technical approach	-Attempt to broaden choice of system options at first agency-level review	-Solicit system proposals using broad need statement; maintain integrity of separate candidate systems

TABLE IV (continued)

PAST PROBLEMS	MAJOR CURRENT CHANGES	MAJOR RECOMMENDED CHANGES
-Multiple information sources: uncommitted industry proposals; pressures for goldplating; high unit costs		-Annual review and fixed-level awards to each selected competitor; agency technical staff assistance
-Narrow technical latitude for competition; paper information; buy-ins	-Greater design latitude; more time for exploration and hardware development	-Commit best competitors to prototype system-level demonstration
CHOOSING PREFERRED SYSTEM		
-Paper competition; complicated source selection; contentious awards	-Some hardware prototypes; less reliance on paper	-Choose system based on mission performance measurements, total ownership costs derived from competitive demonstration and operational tests
-Single contract covering both development and production	-No "total package" awards	
IMPLEMENTATION		
-Overlapping development and production ("concurrency")	-Reduced concurrency	-Independent operational tests before full-production release; strengthened test organizations
-Late and inadequate operational test for production decision	-Emphasis on early and better operational testing	

Source: (COGP 1972)

2. <u>OMB Circular A-109 (1976)</u>

Re-emphasized OMB Circular A-76 which has yet to be seriously implemented, advocates a "systems approach" which emphasized high-level approval of an agency's need prior to the initiation of systems development and production, requires assignment of a program manager upon an approved need, development of an acquisition strategy, and a thorough exploration of alternatives prior to selecting the preferred solution(s).

3. <u>OMB Circular A-11</u>

Provides guidance to all agencies on how to put their Fiscal 1979 budget requests together including instructions for both zero base budgeting and mission budgeting doctrine.

4. <u>Mission Budgeting</u>

Asks the question, "what are the funds for and what is the priority in terms of national defense; and why is it needed?" Mission budgeting will translate to proportioning defense dollars according to national priorities.

5. <u>Zero Base Budgeting</u>

Zero base budgeting requires management to justify everything they are doing or are about to do. Instead of just setting forth incremental proposed budget increases, as has been the past situation, the manager must first justify the baseline program budget and then present alternatives involving any increases or decreases to the baseline program.

6. Federal Acquisition Act of 1977

This basic procurement bill (Senate Bill 1264) promotes the greater use of functional specifications, greater use of commercial products, reduced sole source competition (to promote efficiency), reduced Government surveillance of contractors effort, and directs single, simplified uniform Government wide procurement regulations.

C. OMB CIRCULAR A-109 IMPACT ON FEDERAL LABORATORIES

1. Acquisition Executive

Each agency is to designate an "acquisition executive" to integrate and unify the management process for the agency's major systems acquisition; also monitors agency's practices under OMB A-109 policy.

2. Program Manager Designation

Each agency will designate a "program manager" (P.M.) for each major acquisition. The P.M. will be given budget guidance and a written charter of authority. Each agency will prevent management layering hindering the P.M. ability to perform.

3. Application of Technology Programs

OMB A-109 emphasizes programs based on needs rather than opportunities. Technology programs will not be pushed into hardware development unless there is a tie to a need or a deficiency. Consequently, there may not be an immediate hardware application for much of the technology base program that is conducted in-house. This will probably lead to a

prioritization of technology base program elements based on relationship to near term "needs" or frequency of hardware application.

4. Role of In-House Laboratories

The OMB Circular A-109 laboratory role specifics are detailed in the circular (OMB Circular A-109 1976, para 8F, 10C, 11C). Further details are found in a pamphlet on Major Systems Acquisition (OFPP Pamphlet No. 1, 1976).

Briefly, the laboratories (1) are not to dominate the systems acquisition process, (2) should manage, maintain and stimulate the technology base, (3) should provide objective program management support in analysis, need justification, acquisition strategy preparation, technical consultation, test and evaluation, and in service support (including product improvement). In general, if an in-house R&D Laboratory has a solution to a need, it may propose the concept as an alternative. In doing so, the laboratory acts as a contractor and will largely be excluded from the primary laboratory functions (P.M. support).

The detailed impact on the laboratories is as follows (Dietrich 1976):

a) A closer relationship with the program manager and sponsor agency is inferred. The laboratories are expected to provide objective technical support.

b) There should be less contracting out by both the agency and the laboratory for management and engineering evaluation.

c) Do not contract lifeblood activities (such as planning).

d) Re-orient thinking to "needs" versus "solutions" and apply resources accordingly.

VII. POLITICAL AND ORGANIZATIONAL FACTORS OF LABORATORY ROLE CHANGES

A. INTRODUCTION

The Congressional role in determining the future course of the Navy cannot be overestimated. In terms of the budget, 33% must now be authorized (with efforts in process in the House to increase this to 100%), all of it must be appropriated, and with the emergence of the new Budget Committees, the entire budget is subject to more thorough scrutiny than ever before, as these committees will strive to limit the overall size of the budget thereby further enhancing the competition for increasingly scarce dollars (Henning 1977).

The Federal Laboratory role is being molded in an environment that is not strictly rational. This research makes a fundamental assumption that the environment in which these changes are occurring is a combination of the three conceptual models (rational, organizational, and political) which Allison describes at length in "Conceptual Models and the Cuban Missile Crisis" (Allison 1969). Thus, what cannot be understood from a strictly rational context becomes plausible from an organizational/political viewpoint. Figure 3 is a summary outline of conceptual models.

B. EXAMINATION OF LABORATORY ROLES BASED ON THE RATIONAL MODEL

The rational model is normative and prescriptive. That is, it views a situation as it should be rather than how it is. A rational approach to a problem has sometimes been described as the engineering approach.

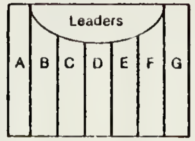
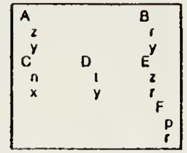
The Paradigm	Model I	Model II	Model III
	National government  Goals (objective function) Options Consequences Choice	National government  Organizations (A–G) Goals SOPs and programs	National government  Players in positions (A–F) Goals, interests, stakes, and stands (r–z) Power Action-channels
Basic unit of analysis	Governmental action as choice	Governmental action as organizational output	Governmental action as political resultant
Organizing concepts	National actor The problem Static selection Action as rational choice Goals and objectives Options Consequences Choice	Organizational actors (constellation of which is the government) Factored problems and fractionated power Parochial priorities and perceptions Action as organizational output Goals: constraints defining acceptable performance Sequential attention to goals Standard operating procedures Programs and repertoires Uncertainty avoidance (negotiated environment, standard scenario) Problem-directed search Organizational learning and change Central coordination and control Decisons of government leaders	Players in positions Parochial priorities and perceptions Goals and interests Stakes and stands Deadlines and faces of issues Power Action-channels Rules of the game Action as political resultant
Dominant inference pattern	Governmental action = choice with regard to objectives	Governmental action (in short run) = output largely determined by present SOPs and programs Governmental action (in longer run) = output importantly affected by organizational goals, SOPs, etc.	Governmental action = resultant of bargaining
General propositions	Substitution effect	Organizational implementation Organizational options Limited flexibility and incremental change Long-range planning Goals and tradeoffs Imperialism Options and organization Administrative feasibility Directed change	Political resultants Action and intention Problems and solutions Where you stand depends on where you sit Chiefs and Indians The 51–49 principle Inter- and intra-national relations Misperception, misexpectation, miscommunication, and reticence Styles of play

Figure 3

Summary Model of Models and Concepts

Rational behavior calls for simplified models that capture the main features of a problem without capturing all its complexities. The simplifications have a number of characteristic features: (1) Optimizing is replaced by satisfying - the requirement that satisfactory levels of the criterion variables be attained, (2) Alternatives of action and consequences of action are discovered sequentaily through search processes, (3) Repertories of action programs are developed by organizations and individuals, and these serve as the alternatives of choice in recurrent situations, (4) Each specific action program deals with a restricted range of situations and a restricted range of consequences, (5) Each action program is capable of being executed in semi-independence of the others -- they are only loosely coupled together.

Action is goal-oriented and adaptive. But because of its approximating and fragmented character, only a few elements of the system are adaptive at any one time; the remainder are, at least in the short run, "givens." So, for example, an individual or organization may attend to improving a particular program, or to selecting an appropriate program from the existing repertory to meet a particular situation. Seldom can both be attended to simultaneously (March 1958).

A major change in the Federal approach to budgeting expenditures occurred in 1965 with the introduction of "planning-programming-budgeting system (PPBS)." This

system attempts to introduce program budgeting as a consistent tool of analysis at all levels of Federal expenditures. A distinguishing feature of PPBS is its focus on the "output," or "mission," of an agency. A program can be defined as a combination of Governmental activities that produce distinguishable outputs (Hyman 1973).

OMB Circular A-109 and the various other procurement reforms (Chapter VI) were initiated to (1) insure a valid program need; (2) broaded the choice of systems options; (3) establish policy and procedures such that there is consideration of life cycle cost effectiveness from program inception. These procurement reforms are in concert with PPBS and tend to increase the rationality of the (rational) PPBS system.

However, the incremental nature of the Government has prevented the widespread acceptance of PPBS (Lindblom 1969), and it is likely that procurement reforms will be met with a similar unwillingness to make major change.

Wildavsky argues:

> "We have to be prepared to accept the possibility that PPBS lacks necessary as well as sufficient conditions, that its disabilities occur not merely in a program implementation but in policy design - that, in a word, its defects are defects in principal, not in execution...PPBS sacrifices the rationality of ends to the rationality of means; that is why seemingly rationale procedures produce irrational results" (Wildavsky 1974).

C. LABORATORY ROLES AND THE BUREAUCRATIC OR ORGANIZATIONAL MODEL

A "one-thing-at-a-time" or "ceteris paribus" approach to adaptive behavior is fundamental to the very existance of

something we can call "organizational structure." Organizational structure consists simply of those aspects of the pattern of behavior in the organization that are relatively stable and change only slowly...organizational short-run adaptiveness corresponds to problem-solving; long-run adaptiveness correspons to learning (March 1966).

The bureaucratic model or organizational behavior rests on the observation that a large, complex, formally structured organization is <u>not</u> a single, monolithic, purposeful machine dominated by a single, optimizing individual, the leader. Rather it consists of semi-independent, even semi-feudal, loosely allied suborganizations, each with a substantial life of its own (McNallen 1973).

The bureaucratic model assumes that organizational behavior, outputs and actions are the combination of pre-programmed outputs of diverse, largely independent, uncoordinated suborganizations of a large bureaucracy, each detecting and reacting to stimuli and functioning according to its standard pattern of behavior. This model considers; (1) the factors of organizational stability and cohesiveness (which involve inertia and maintenance of the status quo); (2) the organizational feasibility of decisions (which involve avoiding disruptions and conflict within the organization).

D. LABORATORY ROLES AND THE POLITICAL OR BARGAINING MODEL

The political model is based on analyzing the power relationships between participants in the organization. The

political model has the individuals at or near the top of an organization as a player in a central competitive game called "politics." Organizational goals and objectives are generally achieved by resolving differences through bargaining. The political or bargaining model makes the assumption that the outputs or actions or behavior of organizations can best be understood as a resultant of the bargaining games. The output in the form of a budget is called a resultant because the final budget outputs are not necessarily those outputs desired by any of the participants involved in the process (McNallen 1973).

Bargaining occurs in two formats. Adaptive bargaining concerns simple adjustments in the level of past agreements (an example would be adjustments to next years budget to achieve previously accepted goals). Intensive bargaining concerns the goals, objectives and policy of an organization and involves adding new programs and activities and the cutback of resources to achieve these disputed goals. Intensive bargaining is the more disruptive of the two types of bargaining.

E. DISCUSSION OF CONCEPTUAL MODELS

It is not a purpose of this thesis to examine potential changing laboratory roles by various conceptual models, but rather to introduce various models with which to analyze an organizational situation.

Analysts think about problems in terms of largely implicit conceptual models that have significant consequences for the content of their thought (Allison 1969).

The bureaucratic politics approach (a combination of bureaucratic and political conceptual models) is a new and valuable perspective on Governmental decision-making. It focuses attention on previously underrated or ignored aspects of policy formulation and implementation. Organizations are biased and parochial; the assumption of the rational actor model are extremely unrealistic. The bureaucratic politics approach appears to be particularly well suited for the analysis of low or mid-level issues and to issues of policy implementation (Caldwell 1976).

F. IMPLICATIONS FOR LABORATORY ROLES

1. Rational

The role and size of the Navy R&D Laboratory system is undergoing a resource drawdown. Various rational procurement policy laws and initiatives will assist in achieving these high Government level goals. The lack of central resource management and agency commitment to central resource management is not rational. There is no apparent method of measuring Government laboratory return on investment; nor is there adquate means to compare the overall efficiencies of in-house versus out-house effort in the appropriate work areas.

The government laboratory system lacks specific high level management objectives and is frequently counter-constrained to meet program objectives.

2. Organizational

The organizational inertia will stabalize the change process. Reorganizations and consolidations will eventually provide the necessary laboratory efficiencies. New procurement policy experience will reveal shortcomings. Critical to the success of the OMB Circular A-109 process will be the early success of the initial trial programs. On the other hand, if A-109 results in increased program duration and dollars to come up with the same old solution, there will be further modifying policy changes undertaken.

A serious conflict for organizational consideration is the inability of the laboratory system to select those people it wishes to terminate. The seniority system can conceivable cause (1) the best people to voluntarily leave; (2) allow the unsatisfactory employees to remain; (3) deny entry of new talents and skills. The long term effects are obvious.

Another organizational conflict is the phenomenon which occurred when NAVMAT assumed command of the laboratories in 1966. Prior to that, the laboratories had been in the direct line of authority exercising chain of command over the laboratories in which they had the greatest interest. The reorganization changed the SYSCOMS role in relation to the laboratories from that of manager to the status of

customer. As customer, the systems commanders have greatly reduced opportunity to influence laboratories policies and management practices. This has an impact on budget acquisition and budget defense. A major laboratory financial channel remains through the SYSCOMS while the management channels are direct to NAVMAT. A further effect of this relationship is the difficulty of enforcing mission assignments to the various laboratories (including the numerous SYSCOM laboratories).

3. Political

The major political factors affecting the NAVMAT laboratory roles are located at the highest Government levels. Congress is trying to regain control of the budget, and DoD expenditures represents a major portion of the controllable budget. The Congress has shown a strong tendancy to micromanage the technical programs within DoD. Changing political administration most often results in new top level management and reform legislation.

The trends are clearly in the direction of prolonged drawdown. The politics of retaining the status quo (fighting reductions-in-force and base closings) will have limited success (according to power politics) unless the perceived military threat increases. Even then, there will be much discussion about what kind of war, where is the war and when, how long will it last and what is the agency's anticipated contribution to the defense effort, etc.

VIII. MANAGEMENT CONCEPTS FOR CHANGE

A. INTRODUCTION

The title of this chapter is not intended to imply that significant change will occur in the existing laboratory system. Rather, the hypothesis is that the management concepts herein are potentially useful regardless of the laboratory role change.

The literature speaks to two major types of planning activities; strategic and tactical.

Steiner contends that:

> "Strategic planning is the process of determining the major objectives of an organization, and the policies and strategies that will govern the acquisition, use and disposition of resources to achieve these objectives" (Steiner 1969).

Tactical plans support strategic planning; are done at lower levels on a regular schedule, have fewer alternatives and greater degree of certainty. In short, tactical plans are used to implement the desired strategy.

B. APPROACH TO CHANGE

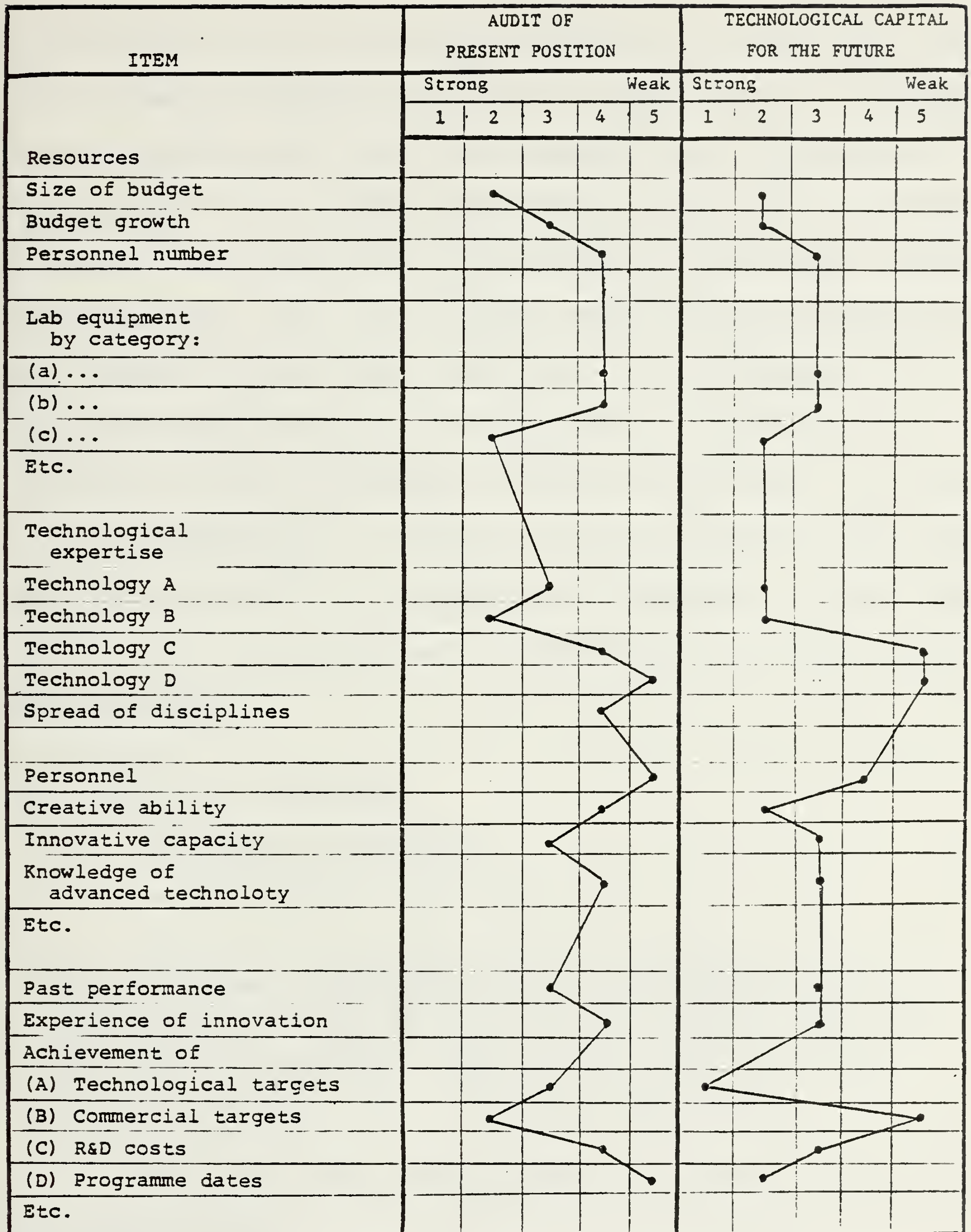
> "At the moment, we should consider whether the advantages of a consciously considered strategy are worth the effort it obviously requires. Four considerations suggest an affirmative answer. They are the inadequacy of stating goals only in terms of maximum profit, the necessity of planning ahead in undertaking rather than merely responding to environmental change and the utility of setting visible goals as an inspiration to organizational effort" (Learned 1969).

The last two considerations are particularly important for the individual laboratories.

C. CORPORATE STRATEGY

Structuring an organization directly for its objectives not only makes them apparent but also specifies the teams of people required to carry them out. It is easy to distinguish at least two kinds of objectives in organizations. The first is maintaining predetermined standards of performance from the repetitive business and functions of the business. The second is bringing about changes to improve the business. For convenience, let us call the first "functional performance objectives" or "performance maintenance objectives", and the second "change objectives" or "improvement objectives". It should be evident that the strategy -- and, therefore, the organization -- for maintaining the status quo will differ from the strategy and organization required for improving it (Sherwin 1976).

There are three main informational inputs to R&D strategy - environmental forecasts, capability analysis, and the corporate strategy. Before deciding on a strategy, it is essential to make a realistic appraisal of one's own strengths and weaknesses. Wishful thinking must play no part in this exercise. Although it is useful to analyse past and present capabilities, these may not be relevant to future needs (Twiss 1974). Figure 4 is a technology audit framework which Twiss suggests could be useful in determining the corporate strategy and the efficient allocation of resources. The first column gives examples of the types of factors to be considered. Navy R&D Laboratory factors would



NOTE: Present audit represents an evaluation of current capability
- Technological capital can only be related to a stated objective for the future and represents the anticipated capability of meeting the objective

Figure 4

Technology Audit Framework

include such data as airfield capability, unique test ranges (live chemical testing, explosive safety limits), instrumentation specialties, etc. The second column contains an assessment of the current position in the form of a profile to aid in the identification of areas of particular strengths or weaknesses. The third column "Technological Capital for the Future" is much more difficult. It's purpose is to evaluate the laboratory's technological capabilities in relation to future demands for future objectives. The concept of technological capital focuses the mind on the future and the real worth of the resources available. "Sunk costs don't count" is another way of describing the real worth of R&D resources.

D. CORPORATE MANAGEMENT

1. Building on Strengths

Peter Drucker says that:

> "Effective executives build on strengths -- their own strengths, the strengths of their supervisors, colleagues, and subordinates, and on the strength of the situation, that is, on what they can do. They do not build on weakness. They do not start out with things they cannot do" (Logistics Management Institute 1971).

The same advise would apply to organizations such as R&D laboratories.

2. R&D as a Business

A major objection to the application of formal planning to R&D is that many important technological inovations originate in a random fashion. Chance plays an important

role and the literature frequently alludes to "serendipity" - the facility of making happy and unexpected discoveries by accident! But no organization is going to invest heavily in technology solely as an act of faith in the hope that by backing the right people 'something will turn up'. On the other hand, it would be a short-sighted management which was not prepared to consider an unexpected innovation on the grounds that it had not been foreseen in the plans (Twiss 1974).

The existing laboratory situation of "apparent" planned R&D is useful in that it provides for a planned R&D program and yet is prepared to absorb the unexpected innovation. R&D is a separate budget activity and there is no requirement that it be driven by current mission element needs.

3. Resource Management Improvement Requirements

Reflecting on the Federal Laboratory resource management as viewed by Congress, defense contractors and informed taxpayers, the sheer magnitude of laboratory expenditures will invite scrutiny and efficiency reform. Recognize that high management level consolidation and coordination appears inevitable and local resource planning should consider this eventuality.

4. Establishing Visible Goals

In the absence of clear and specific NAVMAT goals, establish individual laboratory goals that are visible to all employees. If those goals reflect "change objectives",

so be it. Align the laboratory goals as close to the laboratory mission assignment as possible. Consider aligning laboratory organization directly to the NAVMAT mission assignments.

IX. CONCLUSIONS

The objective of this thesis was an overview of several aspects of the laboratory system as opposed to a detailed examination of any one aspect. There are organizational implications for the Navy Laboratory system that should be recognized by all those engaged in systems acquisition.

As a minimum, the intended implications of the arguments presented here are six. First, the laboratory system has grown very large and complex. The size and nature of laboratory business is seen as a threat to the peacetime sustenance of the military industrial base. Thus there are many pressures for a prolonged drawdown of in-house activities. However, there remains a requirement for the laboratories for (1) SYSCOM and P.M. support; (2) military technology generation, particularly in areas where product demand is sporadic, risky or unprofitable; (3) quick response to recover or achieve a military threat advantage.

Second, the same pressures that a forcing a drawdown put the laboratories in competition with each other for the in-house business. The organizational structure is inadequate for enforcing the mission and roles assignment. In some cases, currently non-conforming expertise has taken years to build, and would be difficult to transfer into alignment with mission and role assignments. Strict mission and role enforcement would result, at least temporarily, in a reduced technological capability.

Third, the NAVMAT laboratory is in a preferred position to centrally organize and distribute corporate resource and capability data as an example for Federal Laboratory Resource Management. This same information would be extremely useful to the operational forces, Navy Laboratory personnel, other DoD laboratories, federal and local government agencies, contractors, etc. Laboratory R&D resource management on a national level is a distinct possibility due to the large expenditures involved.

Fourth, the various acquisition policies will impact the kind of business the laboratories conduct and the manner in which they conduct this business. Acceptance of these policies will be slow, regardless of how directed. The success of trail programs and absence of an interim military crisis or critical need is essential to the success of policy such as OMB Circular A-109.

Fifth, political and organizational factors weigh heavy in the changing make-up of the Navy Laboratory system. It is useful to examine any major problem using the three models (rational, organizational and political). Scientists tend to analyze problems using only the rational model.

Sixth, given that organizational change will continually occur, each organization should have corporate strategic and tactical plans, an attitude or approach to change with the appropriate organizational structure, and a thorough understanding of local corporate resources as well as those of sister laboratories, other DoD laboratories, and industry.

Organizational change should build on strengths and discard weaknesses, recognizing the unique nature of R&D business. There must be a clear understanding of the budget cycle. Current individual budget position is a result of actions taken three or more years ago. The laboratory goals should be clearly visible to all employees and should be closely aligned to the mission assignments. The laboratories should take it upon themselves as a federation to transition activities to improve mission alignment.

Finally, further studies are recommended in areas touched in this thesis, particularly in the area of resource management during organizational change.

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